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"America First!" What are the job losses for Belgium and Europe?

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"America First!"
What are the job losses for Belgium and Europe?

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Abstract

This report is the first to estimate employment effects of looming American protectionism under US president Trump. We study the economic impact of a tightening of US trade policy on Belgium and on every EU member state, which we refer to as "America First" or "Trumpit" (like "Brexit"). Our estimates of EU job losses are based on the interconnectedness of an EU country with the US economy. We do this by taking into account the inter-sectoral linkages between sectors within a country and between EU countries using sectoral input-output data (World Input Output Database, WIOD). Thus, we consider EU jobs involved in direct EU exports to the US, as well as EU jobs corresponding to indirect exports from Europe to the US. Our study covers both exports of goods and services and accounts for services used as an input in goods. Our estimates are based on domestic value added rather than gross export values, since EU jobs are a function of domestic value added only. For Belgium, job losses of Trumpit range between 1200 and 5000 job losses, depending on the US tariff increase. Similarly, for the EU, job losses range between 50,000 and 240,000 jobs that will be lost depending on the US tariff scenario.

For the EU, we find that the export value that will be lost ranges between 5% to 24 %, depending on the extent of the US import tariff increase. This corresponds to European GDP losses that range between 0.1 % to 0.4% of total EU GDP.

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1. Introduction

On January 20, 2017, Donald Trump has been inaugurated as the 45th President of the United States of America. Economists worldwide express their concerns about Donald Trump's intention to increase trade protectionism in order to shield the American economy from foreign importers and protect American jobs. The US being an important trading partner for many countries, economists warn that this protectionist attitude could clearly hurt the rest of the world. Even though this "beggar thy neighbor" policy might have positive short-run effects in the US, economists agree that protectionism is not the way to go in the long run.

Even though the decisional powers of a US president can be limited by US Congress, Donald Trump still has significant powers in international trade policy, particularly in the short term. The Trade Act of 1974 stipulates that the President of the US can increase tariffs up to 15% for a period of 150 days against countries with large balance-of-payments surpluses[3]. Given the current average US import tariff of 2.1%, this means a huge increase in US protectionism. We will therefore use this scenario, in which US import tariffs are increased to 15% in all sectors[4], as an upper bound for the protectionist measures that might be taken under Trump. The policy experiment that we consider as most plausible in this paper involves an increase in tariffs up to 5% in every sector[5], as suggested by a recent article in The Economist (January 7th, 2017, p. 8-9). We will refer to this scenario as "the optimistic scenario" under Trumpit for the remainder of the paper. The "most pessimistic scenario" under Trumpit is where tariffs would be raised to 15%.

Our aim is to study how an increase in US import tariffs results in lower EU exports and a loss in EU jobs as a result of Trumpit. We document our methodology by focusing on Belgium, which is one of the most open EU countries.[6] Afterwards, we extend our approach to all the other EU member states to arrive at job losses under Trumpit for the EU at large.

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[3] See article in *The Economist*: http://www.economist.com/news/briefing/21711498-whatever-he-thinks-dealmaking-wont-help-mr-trumps-trade-negotiations-donald-trumps-trade?fsrc=scn/fb/te/bl/ed/donaldtrumpstradebluster

[4] Note that current US import tariffs are lower than 15% in most sectors.

[5] We assume no change in the sectors that already have a tariff higher than 5%.

[6] Belgium exports around 74% of its output in the manufacturing sector.

Our analysis is unique since we consider both final direct exports from Belgium to the US, as well as indirect exports of Belgian intermediate products that go into third countries' production and are subsequently exported to the US. Thus, even when Belgian intermediate products are not directly exported to the US, but are used as an input either by another Belgian exporting sector or by a third-country's exporting sector, Belgian employment will be affected and we have to take it on board in our analysis.[7] We also take into account that services can be used as inputs in both direct and indirect Belgian exports to the US. Hence, US protectionism will have employment effects in both goods and services sectors involved in direct and/or indirect exports of Belgian goods.

To fully assess the economic impact of a rise in US protectionism, we use the World Input-Output Database (WIOD)[8] which provides useful information about the origin and destination of intermediate and final goods and services in 56 sectors[9] for 43 countries between the years 2000 and 2014[10]. The sectors are defined using the International Standard Industrial Classification revision 4 (ISIC Rev.4) and capture the whole economy, manufacturing as well as services. The WIOD tables allow for the calculation of the value added (VA) in trade of each country-industry pair. The total value added generated by every sector can be split into domestic value added (DVA) and foreign value added (FVA). It is important to take into account this distinction because it is only domestic value added that matters for a correct assessment on the number of domestic jobs likely to be affected and not the total value added. This implies that our estimates tend to be more prudent than other studies not distinguishing between domestic and foreign value added.[11]

Our analysis thus has a number of novel features: i) we consider input-output linkages between sectors within every EU country; ii) we consider input-output linkages between EU countries iii) we take into account both direct and indirect exports to the US in goods as well as services; iv) we split total value added into domestic value added and foreign value added since EU employment is mainly a function of domestic value added.

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[7] Direct exports from Belgium to the US are 4% of total Belgian exports. But Belgian employment involved in US exports is more than just the direct Belgian exports.

[8] Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R. and de Vries, G. J. (2015), "An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production", Review of International Economics., 23: 575–605.

[9] A list of the sectors can be found in Table A5 in the Appendix.

[10] We use the latest version of WIOD that was updated in November 2016 and where we have information up to the year 2014, see http://www.wiod.org/database/wiots16.

[11] See for example, EU Commission, (2017), http://ec.europa.eu/trade/policy/countries-and-regions/countries/united-states/trade-in-your-town/.

Our findings can be summarized as follows.

The employment levels in Belgium associated with direct and indirect Belgian exports to the US are currently[12] around 150,000 jobs. This is the total employment involved in the Belgian production of goods as well as services that are exported directly or indirectly, through the rest of the World, to the US.

The 150,000 Belgian jobs involved in exports to the US correspond to about 3.5% of total Belgian employment. This number gives an idea of the "interconnectedness" between the Belgian and American economy in terms of employment. We calculate this interconnectedness to the US economy for every other EU member state and document results (Table 1 in Section 1.4.).

However, not all of these jobs are potentially affected by a Trumpit scenario. In the press we read that, under Trump's presidency, tariffs are most likely to be increased on US imports of goods only[13]. Therefore, the employees that produce services that are directly exported to the US are not at risk.

Based on WIOD, we break down the 150,000 jobs in Belgium involved in exports to the US into 70,000 Belgian jobs involved in direct and indirect exports of **good**s only to the US. The remaining 80,000 Belgian jobs are involved in the direct and indirect exports of **services** to the US.

Throughout our study, we will assume that services exports to the US will only be affected if they are embedded in goods, since the protection rumors are thus far mainly on US goods imports. Therefore, for Belgium the jobs that we consider to be most at risk are the 70,000 jobs involved in direct and indirect exports of goods (where goods embed services).

Out of the 70,000 Belgian jobs involved in exports to the US in goods, a large majority, i.e. 54,000 jobs, includes exporting activities where Belgium exports directly to the US or supplies intermediates to other EU member states that end up being used for direct exports to the US by these EU member states. The remaining 16,000 Belgian jobs correspond to indirect exporting activities that run through non-EU member states. Thus, we can say that out of the 70,000 Belgian jobs involved in direct and indirect exports to the US, we can distinguish between those indirect exports from Belgium to the US that run through non-EU countries (23%) versus those that run through EU countries (77%).

[12] The most recent data available to us are from the year 2014.
[13] We only consider tariffs imposed on goods, as tariffs on services are not as readily available and difficult to quantify.

Throughout our study, we concentrate on the 77% jobs involving Belgian direct exports and indirect exports that run through EU countries. If we were to include the other 23% of jobs in our analysis, we would need to make a lot of additional assumptions regarding the tariff regime that these non-EU countries would be subject to under a Trumpit scenario, which we want to avoid.[14] Therefore we concentrate on indirect exports running through other EU member states, but realizing that this makes our estimates lower bound estimates of the true employment effects that may arise. However, given that for Belgium the large majority of indirect EU exports runs through other EU countries, this is not too much of a limitation.

Hence the number of Belgian jobs that we consider to be at risk under Trumpit amount to 54,000 Belgian jobs which correspond to 1,2% of total Belgian employment. These jobs support around 8.2 billion dollars of export value in goods (the domestic value added part) that are shipped directly or indirectly from Belgium to the US. These 54,000 Belgian jobs represent the *level of employment* but it does not say anything about how many Belgian jobs would be lost when the US would raise its import tariffs, which is the aim of the subsequent analysis.

For this purpose, we need to consider potential US import tariff scenarios that can occur under Trump. We consider two scenarios. First, the most likely "Trumpit" scenario involves a rise in US import tariffs up to 5% in all goods sectors (*The Economist, January 2017*). In this optimistic scenario, our findings show that there would be a Belgian job loss of around 1,200 jobs (out of the 54,000 Belgian jobs).

Second, we also consider a worst-case scenario, where US tariffs on imported goods are raised to 15% (presidential powers under the US Trade Act of 1976). In this pessimistic scenario, our findings indicate a total job loss for Belgium of 5,000 jobs. When we consider a sectoral breakdown of the job losses we see that job losses mainly occur in the chemical sector (7% of job losses) and the service sectors "Administrative and support activities" (11%) and "Legal and accounting" (10%) sector.

[14] EU member states all fall under MFN tariffs with respect to US imports. However a country like Mexico which has a free trade agreement with the US has zero import tariffs to the US, while African countries and other developing countries may have a preferred import tariff rate (GSP) rather than the MFN tariff rate. We do not know to date, what the US's policy will be on NAFTA countries or GSP countries which are all non-EU countries. Therefore we stick to a policy experiment that only involves EU countries and an increase in the MFN import tariff by the US for these countries.

The corresponding numbers for the EU as a whole are the following: i) 4.8 million EU jobs are involved in direct and indirect exports, through the rest of the world, in both goods and services; ii) of which 3.3 million EU jobs are involved in direct and indirect exports, through the rest of the world, in **goods**; iii) and of which 1.5 million jobs are involved in direct and indirect exports, through the world, in **services**.

Similarly as we did for Belgium, we further break down the number of EU jobs resulting from direct and indirect exports to the US in goods (the 3.3 million jobs) into those that run through non-EU countries, which amount to 0.8 million jobs and those EU jobs that run through other EU countries which amount to 2.5 million EU jobs. These 2.5 million EU jobs account for 272 billion dollars of exports in goods (the domestic value added part of the exports value) that are shipped directly or indirectly from the EU to the US.

Hence the number of EU jobs that we consider in this study to be 'at risk' risk under Trumpit for the EU as a whole is 2.5 million jobs. This is the number of EU jobs in levels of employment involved in producing for direct and indirect exports (via other EU countries) to the US. But it does not say anything about how many EU jobs would be lost when the US raises its import tariffs.

In order to calculate potential job losses from the Trumpit in the EU, we again consider the two potential US import tariff scenarios.

In the "optimistic" tariff scenario, our findings indicate 50,000 EU job losses (of the total 2.5 million EU jobs at risk).

In the "pessimistic" tariff scenario, our findings indicate 240,000 EU job losses (out of the 2.5 million EU jobs at risk).

Germany is the country that is most affected and experiences the largest job losses under Trumpit. When normalizing for country size, we find that both Ireland and Germany are the most negatively affected by Trumpit in terms of job losses.

Note that the results for the "optimistic Trumpit" (5% tariffs) cannot be extrapolated to the "pessimistic Trumpit" scenario (15% tariffs). Even though the imposed tariffs are three times as high in the pessimistic scenario as in the optimistic scenario, the job losses are not exactly three times as high. This is because some sectors have current tariffs that are higher than 5%, like Textiles (9%) and Food (7%). In the optimistic scenario, we therefore assume no change in the tariff in these sectors, whereas we assume these tariffs to increase to 15% in the pessimistic scenario. As a result, the job losses found in both scenarios are not proportional.

In addition to the employment effects, this report analyzes the loss in exports and in the production of output produced. Lost output is output value in dollars that was previously produced by Belgian firms, in goods and services, and was exported to the US in the form of EU goods. This could be either direct exports, e.g. a Belgian car manufacturer exporting cars to the US, or indirect exports, e.g. a Belgian steel company supplying a Belgian or European firm that exports cars to the US. Whenever EU cars face increased protectionism in the US, exports of cars from the EU to the US will go down, which reduces the output sold by Belgian car as well as steel firms. The sum of both will be referred to as lost "direct and indirect exports" which corresponds to the loss in EU "output produced".

For Belgium, in an "optimistic" Trumpit scenario, we find an output loss of 467 million dollars which represents 5.7% of the total output involved in direct and indirect exports of Belgian firms to the US (5.7% of 8.2 billion dollars). The corresponding output loss for the Belgian economy represents a drop of 0.1% of Belgian GDP[15].

For Belgium, the "pessimistic Trumpit" scenario results in a decrease in Belgian output (or direct and indirect export value) of about 2 billion dollars and a loss of (direct and indirect) Belgian exports of 24%. The corresponding output loss for the Belgian economy in pessimistic Trumpit represents a drop of 0.4% of Belgian GDP.

For the EU as a whole, the loss in output value in the "optimistic" Trumpit scenario amounts to 14.3 billion dollars, which corresponds to a 5.3% loss of total EU output involved in direct and indirect exports in goods to the US (272 billion dollars in 2014). This corresponds to an output loss for the EU economy of 0.09% of European GDP[16].

In the "pessimistic" Trumpit scenario, the output loss for the EU as a whole amounts to 66 billion dollars, which is 24% of direct and indirect EU exports in 2014 (272 billion dollars) and corresponds to a loss in output of 0.4% of European GDP.

The remainder of the report is structured as follows. In Section 2, we first discuss the current US tariffs on imports. Based on the latest available data, we report exports to the US and employment involved in supplying the US market directly and indirectly. The methodology involved in obtaining the employment numbers is briefly discussed in the main text with more details reported in the Appendix.

[15] In 2014, Belgian GDP amounted to 476 billion dollars (from WIOD).
[16] In 2014, European GDP was 16.6 trillion dollars (from WIOD).

In Section 3, we discuss job losses resulting from an increase in US import tariffs where we consider two distinct scenarios. The most likely scenario that we discuss is a general rise in the sector-level US import tariffs up to 5% and the worst case scenario is an increase in US import tariffs up to 15%. In Section 4, we discuss output losses resulting from Trumpit as a percentage of GDP. In our analysis we first present results for Belgium and then extend it to the other EU member states to assess the EU wide effects of Trumpit. Section 5 concludes the analysis.

2. Descriptive statistics on US Tariffs and Belgian Exports to the US

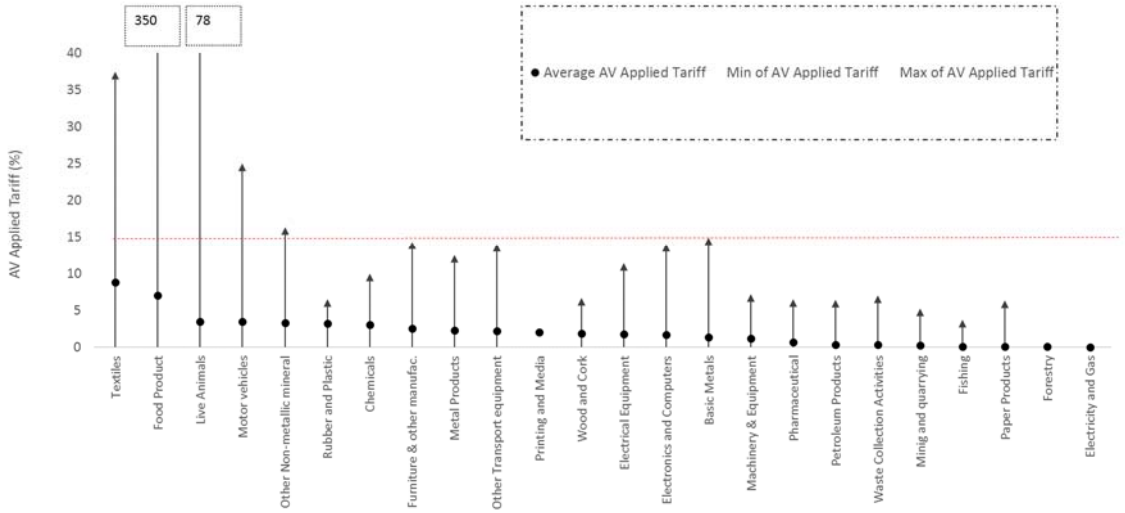
In this section we will first discuss the current level of US import tariffs and the policy actions that are likely to be taken under "Trumpit". Next, we discuss the level of Belgian exports of both goods and services to the US, either directly or indirectly through other countries. The final subsection takes stock of the Belgian employment, both for the goods and services sectors, that is involved in producing direct and indirect exports to the US.

The US and the Member States of the EU are part of the 162 members of the World Trade Organization. WTO membership implies that nations are automatically assigned the status of "Most Favored Nation" (MFN). WTO membership thus implies several advantages in terms of accessing foreign markets, as WTO members have lower trade barriers both in terms of ad valorem (AV) tariffs and quotas, and regulatory barriers.

Figure 1 shows the current average AV tariffs, defined as the tariff charged as fixed amount per quantity, that the US imposes on Most Favored Nations, which includes all the Member States of the EU. Although WTO membership guarantees low AV tariffs, these vary across sectors. Figure 1 presents the average US tariff imposed on EU sectors[17], represented by the big black dot. The highest average tariff is around 3%, imposed on goods in the "Textiles" sector. The highest maximum tariff is 350% on "Other manufactured tobacco and manufactured tobacco substitutes" (HS6), which is a subsector of "Food Products". On average across all sectors, the US import tariff equals 2.1%.

[17] We only consider tariffs imposed on goods, as tariffs on services are not as readily available and difficult to quantify.

Figure 1: US ad valorem (AV) tariff under the "Most Favored Nation" (MFN) (2014)



Source: Own calculations based on WTO Integrated Database

2.1. Belgian Exports of GOODS to the US

In order to quantify the effect of increased US trade protection on the Belgian economy, we need to identify the trade flows from Belgium to the US. In this section 2.1, we consider trade of goods, which includes Manufacturing, Agriculture and Mining. Trade in services will be discussed in subsequent Section 2.2.. As mentioned in the introduction, goods can be exported directly to the US or indirectly. These indirect exports refer to intermediate Belgian inputs that are embedded in the exports of other Belgian sectors or other countries that in turn export to the US.

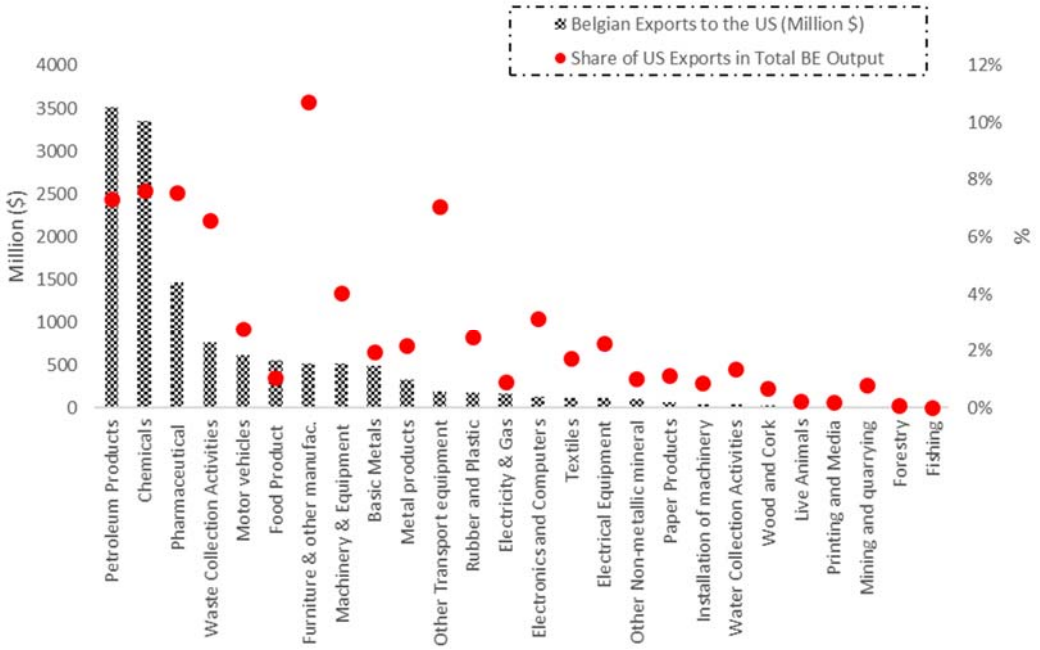
Direct Belgian exports of Goods to US

US protectionist measures are likely to be more important for Belgian sectors in which the direct exports to the US are higher. Therefore in the figures below we start by showing the direct connection between the US and Belgium in goods exports, which allows us to analyze the importance of the US market in the Belgian good sectors[18].

Figure 2 below displays the direct Belgian exports of goods to the US (left axis) and how much this represents as a share of total output (right axis) for each Belgian goods sector. The same is depicted in Figure 3, but the dot now represents the share of Belgian exports to the US in total Belgian exports. All numbers are calculated using gross values.

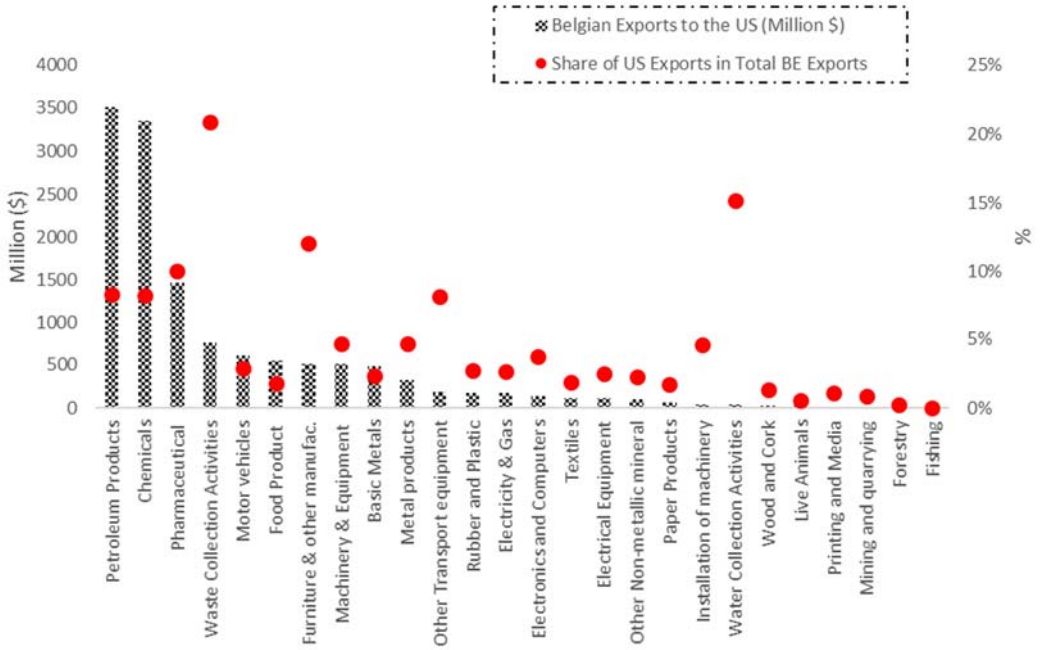
[18] These sectors include the following Nace Revision 2 codes: "A- Agriculture, forestry and fishing", "B-E Industry (except construction)" and "C-Manufacturing".

Figure 2: Share of Belgian Direct Exports to US with respect to Total Output (2014) (Goods)



Source: World Input-Output Database (WIOD)

Figure 3: Share of Belgian Direct Exports to US with respect to Total Exports (2014) (Goods)



Source: World Input-Output Database (WIOD)

From Figure 2, we see that US exports represents more than 5% of total output in six sectors: “Petroleum Products”, “Chemicals”, “Pharmaceutical”, “Waste Collection”, “Other transport equipment” and particularly “Furniture and other Manufacturing” where US exports account for more than 10% of total gross output. But the US market is of limited importance to Belgium in many other sectors such as “Fishing”, “Forestry”, “Mining and Quarrying”, “Printing and Media” and “Live Animals”.

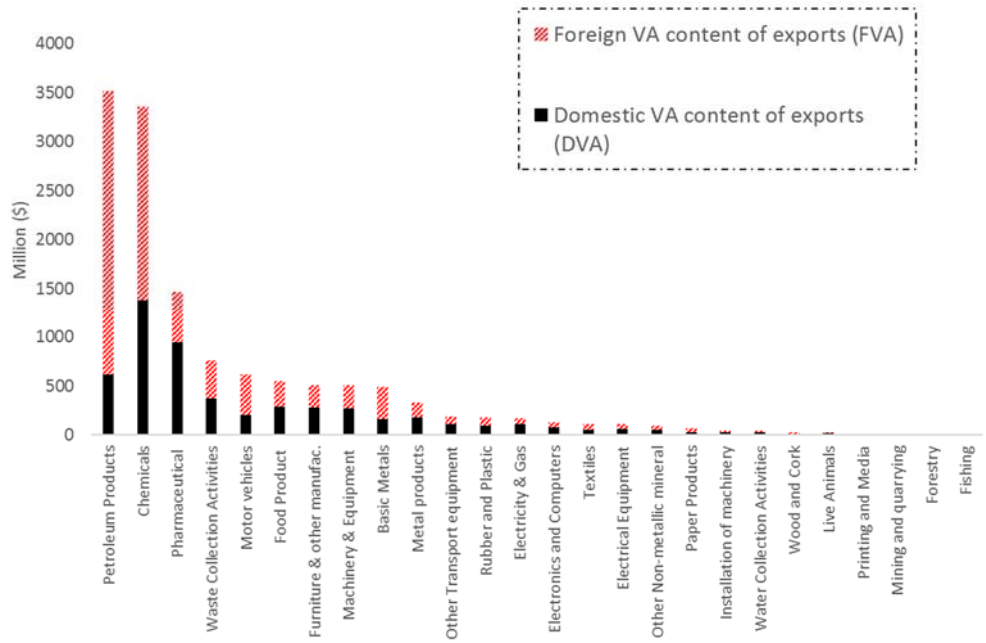
From Figure 3, we see that the US market accounts for more than 5% of total exports in seven sectors (“Water Collection Activities” in addition to the six sectors we had before). Sectors in agriculture tend to be less exposed to the US market both in terms of total output and total exports. Aggregating across all sectors, direct exports to the US account for about 4% of total direct Belgian exports.

Disentangling domestic and foreign Value Added for Goods (DVA and FVA)

However, different sectors require different inputs, some of which come from countries other than Belgium. In order to properly assess the Belgian employment involved in direct US exports, we therefore have to disentangle domestic Belgian Value added from Foreign value added in every sector.

Figure 4 disentangles direct Belgian exports to the US (in million dollars) in terms of Domestic Value Added (DVA) and Foreign Value Added (FVA) based on the World input-output Tables (WIOD data). While “Petroleum Products” is ranked first in terms of export value from Belgium to the US, it is clear from Figure 4 that for “Petroleum”, FVA exceeds the DVA content of this sector’s exports value much more than in say “chemicals”. This implies that, for “Petroleum products”, much of the value added (VA) in this sector is actually generated outside of Belgium (FVA >> DVA). Therefore, a decrease in Belgian exports of “Petroleum Products” to the US, will have a lower impact on the Belgian economy than a decrease in “Chemicals” exports from Belgium to the US.

Figure 4: FVA and DVA of Belgian Exports to the US (2014) (goods)



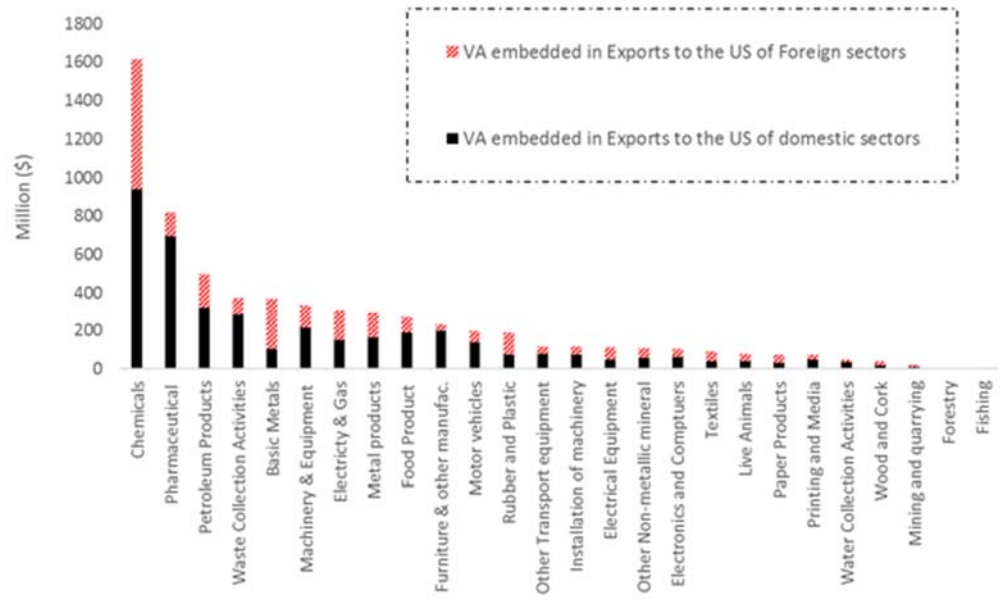
Source: Own calculations based on World Input-Output Database (WIOD)

Indirect Belgian exports of Goods to US

Up to this point we only documented Belgian *direct* exports. However, Belgian production is not only exported to the US directly as goods, but much is also used as inputs by other sectors (both domestic and foreign) in the production of goods that are eventually exported to the US.

Figure 5 documents these "indirect exports" for every Belgian goods sector. Around 1.6 billion dollars of value added produced in the Belgian "Chemicals" sector, for instance, is transformed by other sectors and exported to the US in the form of other products. The domestic sectors account for about 900 million dollars of these indirect exports, whereas the remaining 700 million dollars is exported to the US through sectors in other countries. For the Belgian "Pharmaceuticals" sector the situation is different, as most production is exported indirectly to the US through other Belgian sectors (700 of the 800 million dollars of VA) and only little through other countries. When considering indirect exports, the "Petroleum" industry's importance falls. Relative to other sectors, "petroleum" is used less as an input in other sectors' exports than it was exported directly as final good.

Figure 5: Indirect Belgian exports (goods): VA embedded in Exports to the US of other Domestic and Foreign sectors



Source: Own calculations based on World Input-Output Database (WIOD)

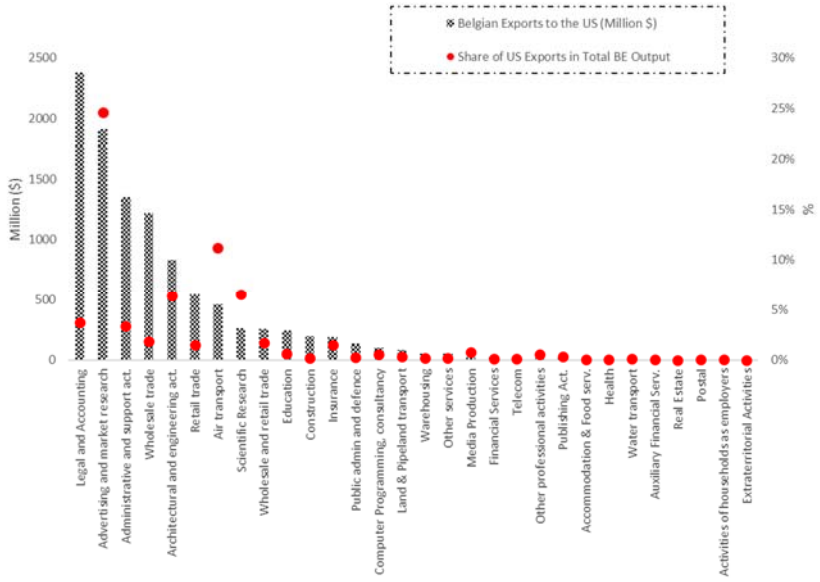
2.2. Belgian Exports of SERVICES to the US

Thus far, our analysis focused on the goods sectors. Goods account for 63% of total exports and 31% of total gross output of Belgium. The services sectors, on the other hand, account for 37% of total Belgian exports (44% of exports to the US), indicating they represent an important part of the Belgium economy. Services too are exported directly to the US or indirectly through other domestic sectors (goods and services) and other countries. We first consider direct services exports.

Direct Belgian exports of Services to the US

Figure 6 shows for each services sector, the direct Belgian exports to the US (left axis), as well as the share of these exports in total Belgian output (right axis). Most of these sectors have very limited exposure to the US market. However, there are a few exceptions where US exports represent a large share of the sector's total output. For example, exports to the US in "Advertising and market research" represent 25% of its total output, as indicated by the right axis. Other sectors where the US demand is important in total Belgian services demand include "Air transport", "Scientific research" and "Architectural and engineering act.", where the US market represents 11%, 7% and 6% of total output, respectively.

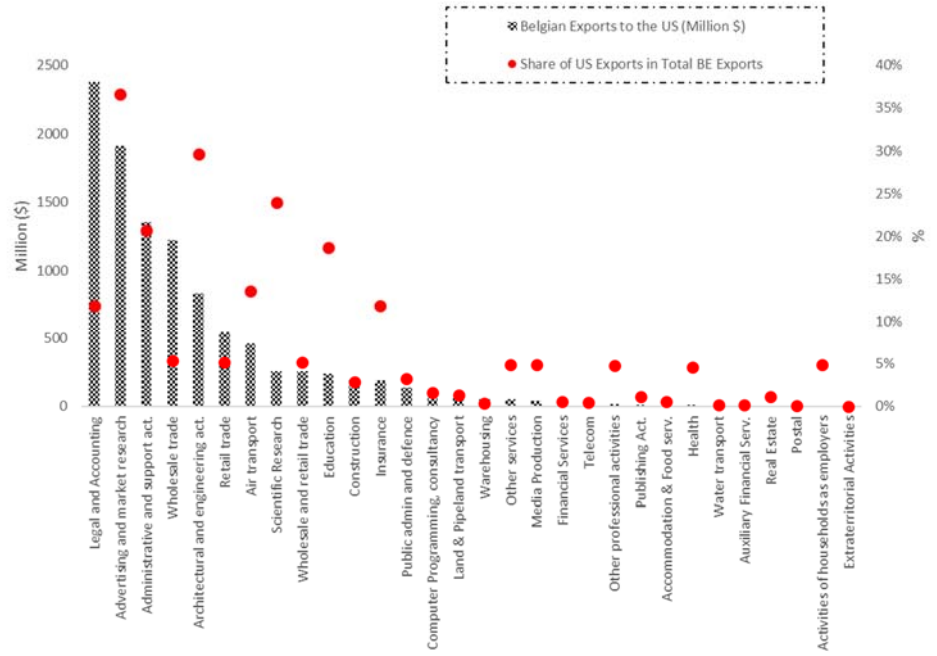
Figure 6: Belgian Direct Exports to US and its share in Total Output (2014) (services)



Source: World Input-Output Database (WIOD)

Figure 7 shows, for every services sector, the direct Belgian exports to the US (left axis), as well as the share of these services exports in total Belgian exports (right axis). For sectors like "Advertising and market research" and "Architectural and engineering act", the US market represents 37% and 30% of what is consumed outside of Belgium, respectively. Other sectors where the US represents more than 20% of total Belgian exports are "Scientific Research" and "Administrative and support act.".

Figure 7: Belgian Direct Exports to US with respect to Total Exports (2014) (services)

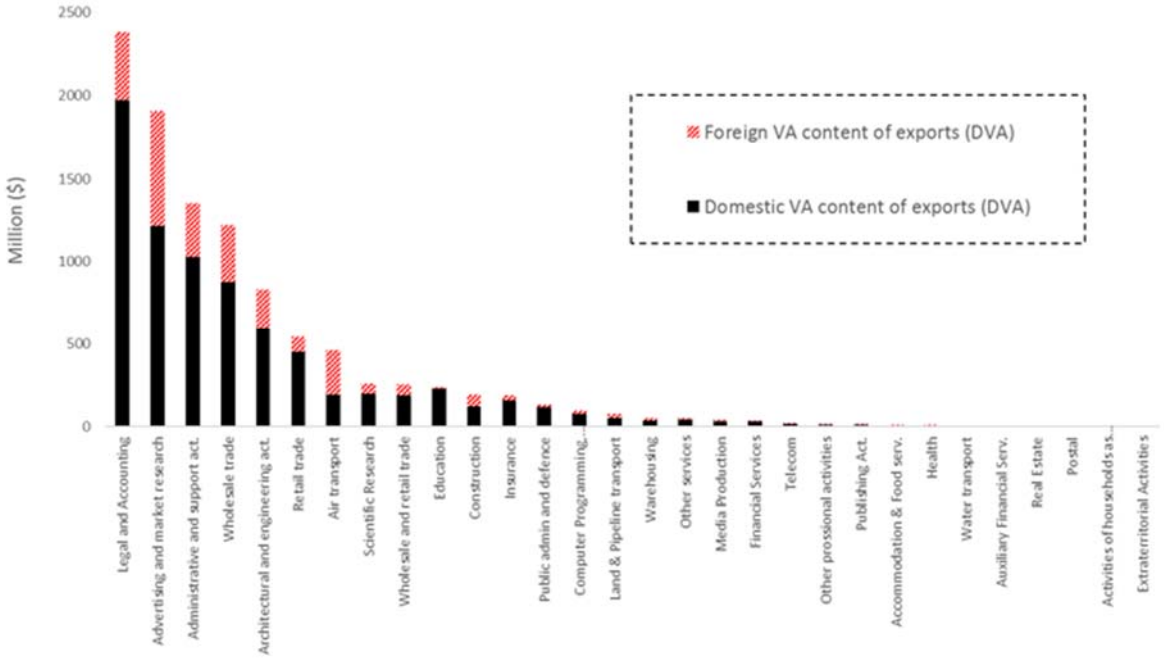


Source: World Input-Output Database (WIOD)

Disentangling domestic and foreign Value Added for Services (DVA and FVA)

We now disentangle the value added (VA) of Belgian exports of *services* to the US into what is produced domestically (DVA) and abroad (FVA Figure 8 shows that the majority of exported VA of Belgian services is generated domestically. The contribution of foreign sectors to the Belgian services exports (FVA) is much lower than in the manufacturing of goods (see Figure 4 above).

Figure 8: FVA and DVA of Belgian Exports to the US (2014) (services)

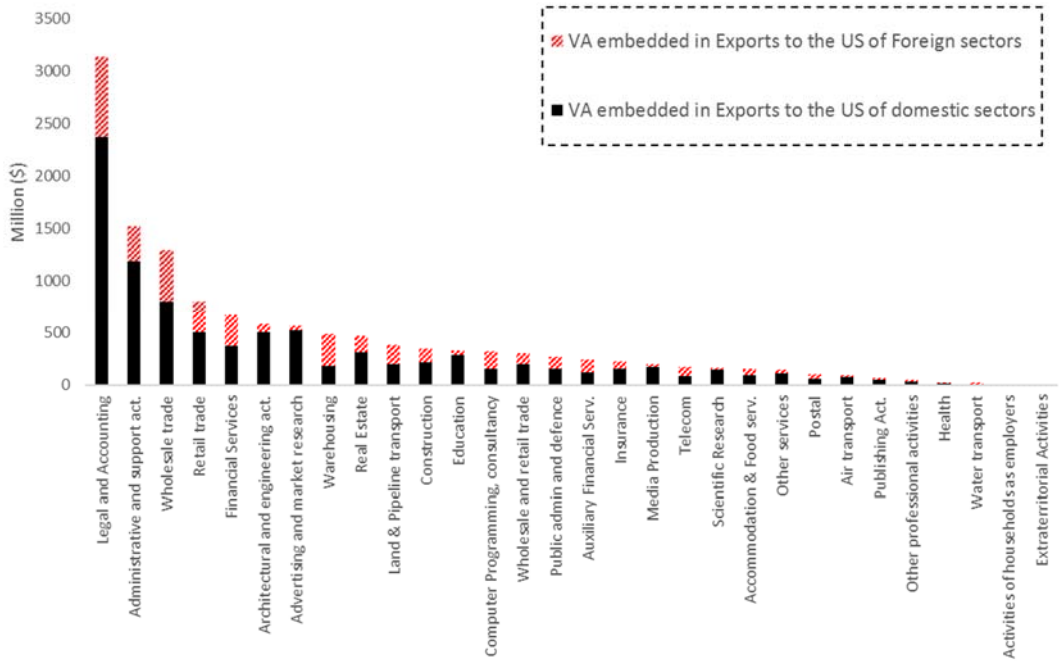


Source: Own calculations based on World Input-Output Database (WIOD)

Indirect Belgian exports of Services to the US

The previous section documented direct exports of Belgian services to the US. However, manufacturing industries are increasingly using services as part of their production process. Thus, it is important to include these indirect exports of services from Belgium to the US in the analysis. Analogous to Figure 5 for goods, Figure 9 shows how services are used in other sectors (both domestic and foreign) to generate worldwide exports to the US. The sector "Legal and Accounting" appears to be used most to generate exports to the US, mainly by other Belgian sectors (represented by the black part of the bar). "Administrative and support activities" and "Wholesale trade" are two other services sectors that are characterized by high indirect exports to the US.

Figure 9: Indirect Belgian exports (services): VA embedded in Exports to the US of other Domestic and Foreign sectors



Source: Own calculations based on World Input-Output Database (WIOD)

2.3. Belgian Employment involved in Exports to the US (direct & indirect; goods & services)

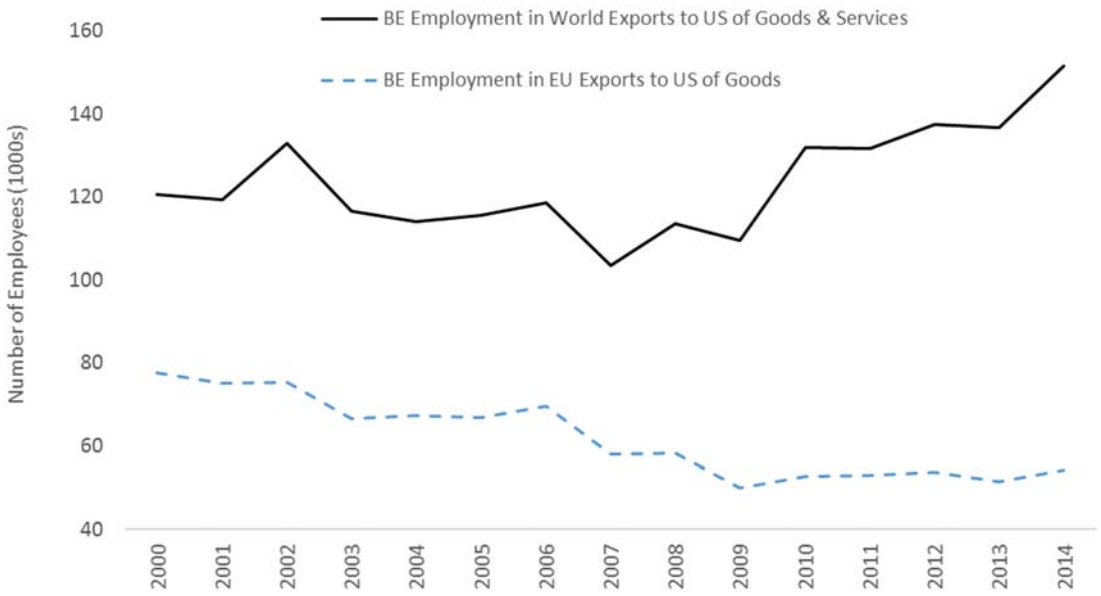
In this section, we calculate the number of jobs in Belgium that depend on the US market. This number represents the "interconnectedness" of the Belgian economy with the US economy in terms of employment. For this purpose, we calculate[19] the sum of two numbers. First, based on WIOD input-output tables, we compute the amount of Belgian employees active in the Belgian goods and services sectors that produce goods or services that are directly exported to the US. Second, we compute the number of Belgian employees involved in the production of inputs used in the production of other goods and services (both in Belgium and the rest of the world) that are then exported to the US. The sum of both numbers corresponds to the total amount of Belgian employees involved in world exports to the US in both goods & services.

In 2014, this amounts to around 150,000 employees (rounded), which corresponds to about 3.5% of total Belgian employment. The solid line in Figure 10 shows the evolution of this number over time. In Figure 10, we also show an additional dotted line, which gives the evolution of the number of Belgian jobs involved in EU exports to the US of goods, which will be discussed in more detail below. The number of ca. 150,000 employees is a measure of Belgium's interconnectedness with the United

[19] See the Appendix for more information on how the numbers in this section were derived.

States. In the past years, this number has risen sharply, indicating that both economies have become increasingly interconnected (in terms of employment). In the next section, we also document the interconnectedness with the US for all other EU countries.

Figure 10: Total Belgian employment involved in producing worldwide exports (of goods & services) to the US



Source: Own calculations using WIOD and Eurostat

In Section 2.2. we learned that Belgium exports a great deal of services to the US and that Belgian services are used as an input in many other sectors (goods and services) in the production of exports to the US.

In our policy experiment, we assume that the US protectionism that is likely to take place under president Trump will involve an increase in the import tariffs on goods into the US[20]. However, it should be clear that services will also be affected since they are embedded in exports of goods to the US. Our methodology therefore differs between the goods and services sectors. For each Belgian goods sector, we calculate the number of employees producing (i) direct exports to the US or (ii) inputs used in the (domestic or foreign) production of other goods to the US. For each Belgian services sector, we compute the number of employees producing services that are used as inputs in the (domestic or foreign) production of goods to the US.

[20] We leave aside the possibility that Trump may also raise tariffs on services imports.

In our assessment of indirect Belgian exports, we focus on the input-output structure between Belgium and the other EU countries. The reason is that this captures the large majority of interlinkages, since the percentage of trade with the rest of the world is small compared to the Belgian trade with its EU partners (EU countries represent around 77% of Belgium's indirect exports).

Thus, in this paper we limit ourselves to the exports of the EU countries to the United States, as this is the most important indirect linkage for Belgium. Put differently, when considering indirect exports of Belgium, we only consider those goods and services that are used in the production of exports from other EU countries to the US. Our results can therefore be considered as prudent estimates of the job losses, as the real impact of Trumpit on Belgian employment is likely to be higher.

Let us give the following example. In Figure 11, we consider goods only. Let us take the example of the "Chemicals" sector in which 6,000 employees produce *goods* that are either (i) exported directly from Belgium to the US or (ii) are used as inputs in the production of goods and services exported to the US by other countries in the world. The 6,000 can be broken down as follows. Around 5,000 employees produce for direct Belgian exports to the US or for exports of goods by other EU countries. Around 900 employees produce for indirect exports of goods by non-EU countries. The remaining 100 employees produce chemicals that are used, either inside or outside of the EU, in the production of exports to the US of *service*s.

For the remainder of our analysis, we focus on the 5,000 employees involved in the direct and indirect exports (via other EU countries) of goods, as these are the most relevant ones as they are most likely to be affected by Trumpit.

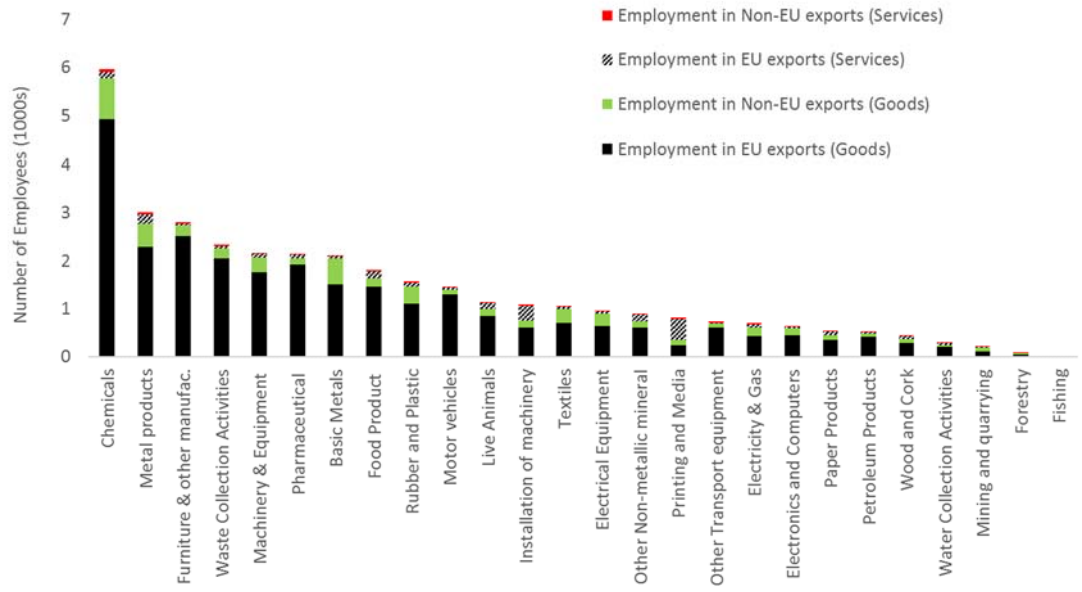
Summing the relevant bars in Figure 11 across all sectors, we find that 27,200 Belgian employees are active in the Belgian goods industries to produce goods that are exported directly to the US or indirectly by EU countries in the form of other goods.

In Figure 12, we engage in the same breakdown for services. There are two things worth noting. First, the bars are much higher, indicating that much more Belgian employees are active in services which are exported directly or indirectly to the US than there are in the goods sectors. Employment involved in satisfying the US demand for Belgian services, particularly in "Legal and Accounting" and in "Administrative Services", is much higher than for goods. More than 50,000 employees are active in these sectors. A lot of the employees in the services sectors produce direct exports of services, (grey part of the bars). As we explained before, these employees are not likely to be affected by a Trumpit that raises import tariffs on goods but not on the US imports of services.

Summing the relevant black bars in Figure 12 across all services sectors, we get the jobs involved in indirect service exports, i.e. services embedded in the exports of goods to the US from Belgium and other EU countries. The sum of these black bars across all sectors is 26,800 employees, which is small compared to the sum of the total bars (116,087 employees in services) but almost as high as the number we obtained in Figure 11 for the goods sectors (27,200 employees).

Thus, out of the 150,00 Belgian jobs involved in producing for the US demand (3.5% of Belgian employment), we find around 54,000 Belgian employees (26,800 + 27,200) to be 'at risk' under Trumpit, which corresponds to around 1.2% of total employment in Belgium . Thus, 54,000 jobs is the number of Belgian employees that produce goods that are exported directly to the US, or goods and services that are exported indirectly by EU countries in the form of goods. The evolution of this number is shown by the dotted line in Figure 10. It represents around one third of the total number of Belgian employees somehow exporting to the US[21]. Note, however, that these numbers reflect employment levels. Thus, whenever there is a trade policy shift like Trumpit, the job losses will be a fraction of these employment levels and will be discussed later.

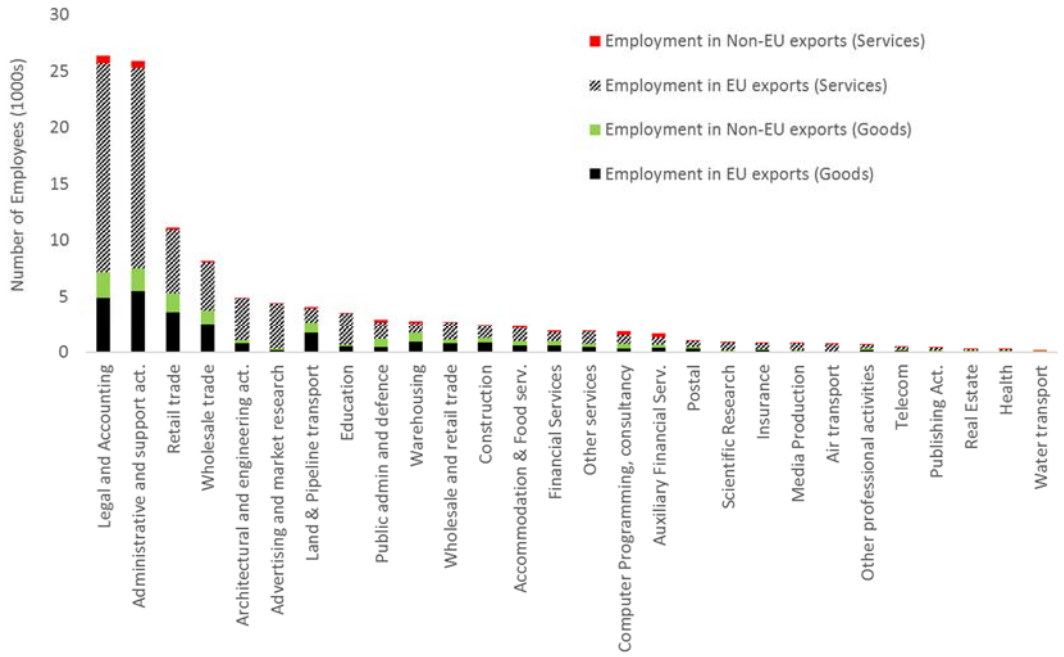
Figure 11: Breakdown of Belgian employment involved in exports to the US (goods) (2014)



Source: Own calculations using WIOD and Eurostat

[21] From Eurostat, we see that total Belgian employment in 2014 was equal to 4,534,100 people.

Figure 12: Breakdown of Belgian employment involved in exports to the US (services) (2014)



Source: Own calculations using WIOD and Eurostat

2.4. EU interconnectedness with the US economy in 2014

We now extend our analysis to the EU as a whole and study the interconnectedness of all EU countries with the US economy. In the previous section, this analysis was performed for Belgium and we found that around 150,000 Belgian employees produced goods and services that were either exported directly to the US or indirectly through other countries in the world. We believe this number to be an indicator of how closely linked the Belgian economy is with the United States. It gives an idea of the dependency of Belgium, in terms of employment, on the US market. In case of a shock in the US (increased trade protection, war, economic crisis), it indicates how many Belgian employees are at risk. But since this is an absolute number it is bound to be a reflection of country size and therefore does not necessarily provide a very accurate measure of "interconnectedness with the US".

A normalization is therefore better, so we divide by the size of the active employment population. For Belgium, the total active employment amounts to 4,500,000 employees. Thus, for Belgium, the 150,000 employees that depend on the US market represent 3.3% of the total active employment population. We now do this for every EU member state and we consider the normalized "interconnectedness of the EU member state with the US", which is listed in Table 1. For Germany there are 1.2 million employees producing for the US, as can be seen in column 1 of Table 1. This makes Germany the EU country that is most connected with the US economy in absolute numbers. But when we normalize for Germany's total active employment, its interconnectedness with the US represents 2.76%, which is lower than some other EU countries such as Ireland (5.02%), Belgium

(3.32%) and the Netherlands (3.64%). Cyprus appears to be least connected, with only 4,000 employees that are involved in producing its direct and indirect exports to the US, or 1.16% of total employment.

This interconnectivity of every EU country with the US economy will be an important factor in the number of job losses (next section) that each EU country will incur when "Trumpit" happens, which is why we document the EU differences in US interconnectivity in Table 1.

Table 1: Interconnectedness of each EU Member State with the US economy (2014)

Interconnectedness with the US economy			
Country	Employment involved in direct and indirect exports to the US (000) (1)	Total active employment (000) (2)	Indicator of US Interconnectivity (3)=(1)/(2)
AUT	88	4263	2.05%
BEL	150	4500	3.32%
BGR	59	3434	1.72%
CYP	4	362	1.16%
CZE	114	5109	2.22%
DEU	1178	42662	2.76%
DNK	50	2794	1.81%
ESP	191	18022	1.06%
EST*	11	606	1.77%
FIN	57	2507	2.27%
FRA	456	27394	1.67%
GBR	802	30754	2.61%
GRC	30	3999	0.75%
HRV	26	1575	1.66%
HUN	112	4216	2.65%
IRL	98	1940	5.02%
ITA	487	24339	2.00%
LTU*	19	1318	1.40%
NLD	317	8711	3.64%
POL	237	15731	1.51%
PRT	58	4513	1.28%
ROU	125	8635	1.45%
SVK	36	2223	1.62%
SVN	16	931	1.76%
SWE*	97	4737	2.04%
EU Total*	4,820	225,334	2.14%

Source: Own calculations based on WIOD and Eurostat

Notes:

1. *The indicator of US interconnectivity is based here on employment for each EU country in direct exports and indirect exports (via the world) of both goods ànd services. An alternative measure could have been to construct the indicator on the basis of the employment that is "at risk" given that US protectionism is likely to involve import tariffs on goods only. Such and indicator would then also reflect the sectoral composition of a country's exports.*
2. *Employment data on Eurostat is missing for the following country-sectors (Nace rev. 2): Estonia: C19, C21, C24, C30, H51, K66; Lithuania: C19; Sweden: C20, C21, H52, H53, M71, M72; Malta, Latvia and Luxembourg contain too many missing sectors and were therefore deleted. The EU total also excludes the missing countries/sectors.*

3. 'Trumpit' and job losses

3.1. Methodology

Now that we have established the number of jobs in levels involved in EU exports to the US, we consider the potential job losses due to "Trumpit" in this section. The methodology will briefly be explained below. More details can be found in the Appendix. We believe this analysis to be more precise than other studies since it takes into account inter-sectoral linkages and linkages across EU countries.

The policy experiment that we label "Trumpit" involves an increase in US import tariffs on EU goods. Currently, the average US tariff on EU imports across all sectors equals 2.1%[22]. In a first step, we consider the extent of the tariff increase, allowing for 2 scenarios. The most likely scenario involves a US tariff increase to 5% in all sectors[23] under "Trumpit" (as suggested by The Economist, January 7th, p. 8-9). The worst-case scenario is where Donald Trump uses his full decisional powers[24], as stipulated by the Trade Act of 1974, to increase tariffs to 15% in every sector[25].

The second step is to investigate how intensely export flows react to a change in US import tariffs and domestic US prices. Typically, this sensitivity is given by price or trade elasticities. As a first pass in our analysis we use a common value for the trade elasticity of -2 across all sectors. This implies that for every 1 percentage point increase in US import tariffs, US imported quantities from each European sector are assumed to go down by 2%. This trade elasticity can be regarded as a prudent one with many products and sectors displaying higher trade elasticities (see, for instance, Hanson, 2005; Head and Ries, 1999 and Hummels, 1999).[26]

To translate a US import tariff increase into a corresponding increase in US domestic prices we use Equation (1) in the Appendix. For convenience, we assume complete pass-through of tariffs into domestic prices[27], such that predicted changes in US import quantities equal predicted changes in US

[22] In order to map the tariff changes (HS6 classification) onto employment changes (ISIC Rev.4), we aggregate tariffs at the sectoral level. This is done by taking the unweighted average across all individual products.
[23] We assume no change in the sectors that already have a tariff higher than 5%.
[24] See article in The Economist, December 10th: http://www.economist.com/news/briefing/21711498-whatever-he-thinks-dealmaking-wont-help-mr-trumps-trade-negotiations-donald-trumps-trade?fsrc=scn/fb/te/bl/ed/donaldtrumpstradebluster.
[25] Note that current US import tariffs are lower than 15% in all sectors.
[26] Our own estimates of the trade elasticities using the BACI dataset revealed relatively low heterogeneity across sectors, which justifies the use of a common value for all sectors.
[27] Complete pass-through means that all cost increases such as higher import tariffs are passed on to US consumers completely. See the Appendix for more details.

import values. Thus, given our trade elasticity, we obtain that for every 1 percentage point increase of US import tariffs, the export value from the EU to the US will drop by 2%.

Finally, we compute the effect of this drop in export values exported from the EU to the US on EU employment to arrive at the number of jobs lost. For this purpose, we use the WIOD data to estimate an employment elasticity (see Appendix for more details). The employment elasticity measures how employment depends on total output produced which we estimate as an average across all EU countries and all sectors. Using the same employment elasticity across the EU is clearly a limiting assumption, but the advantage is that all the variation in results is then explained by EU member state differences in their connectivity to the US.

We estimate the employment elasticity by regressing total employment in every sector in every EU country on total output in gross terms (for goods). The employment elasticity that we obtain in this way equals 0.40, which means that employment in a typical EU sector goes down by 0.40% if the value produced decreases with 1%. Therefore, a 1% drop in value exported is assumed to reduce employment that produces these exports by 0.40%. The employment elasticity that we find here is not too different from the employment elasticity used by Van Biesebroeck and Vandenbussche (2016) in a recent European Commission report.

With the employment elasticity obtained from the WIOD data, we then calculate the percentage drop in employment that results from the tariff increase to 5% in every sector. Multiplying these percentage drops per sector by the number of Belgian (or EU) employees that currently produce Belgian (EU) direct or indirect exports of goods to the US (numbers for 2014), yields the employment loss in every Belgian (EU) sector. Summing across all sectors then gives the total number of Belgian (EU) employees lost after Trumpit. The job losses obtained this way are reported in the next section. We first discuss results for Belgium and extend to the EU as a whole in a later section.

3.2. Trumpit and Employment losses for Belgium and the EU

We first discuss the results of an increase of sector-level US import tariffs up to 5%. In a later section we then discuss job losses when tariffs are raised to 15%. We present results for Belgium and then apply the same methodology to the EU as a whole.

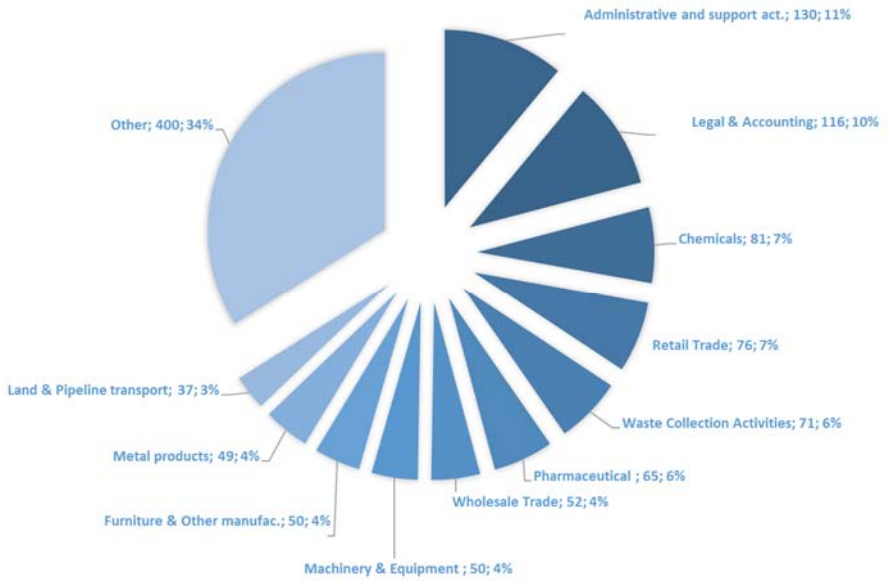
3.2.1. Belgian job losses due to Trumpit

Using the methodology described in the previous section, we find overall employment losses for Belgium that range between 1,200 – 5,000 jobs lost due to Trumpit, depending on the magnitude of the US import tariff.

The affected employees are those that produce direct exports of Belgian services to the US and those that produce goods and services indirectly exported to the US by other EU countries in the form of goods. As explained before, goods and services exported by *non-EU countries* are not considered in the analysis.

Figure 13 breaks down the employment losses of Trumpit for Belgium by sector. The sectors "Administrative and support activities", "Legal and accounting" and "Chemicals" would be hit hardest by increased US trade protection, with job losses in absolute levels of 130 jobs, 116 jobs and 81 jobs, respectively.

Figure 13: Sector-level overview of the employment loss in Belgium



Source: Own calculations using WIOD and Eurostat

Each label contains the name of the sector, the number of employees lost in absolute number and the share this represents in the total number of 1,178 employees lost. The "Other" category refers to all the additional sectors described in Table A5 in the Appendix.

3.2.2. EU-wide job losses due to Trumpit

For the EU as a whole, we find job losses to range between 50,000 and 240,000 EU jobs lost, depending on the magnitude of the US import tariffs.

Table 2 presents a summary of the estimated job losses for Belgium and the EU, depending on an optimistic (5%) versus pessimistic (15%) US import tariff scenario.

Table 2: Job losses for Belgium and EU in both scenarios of Trumpit

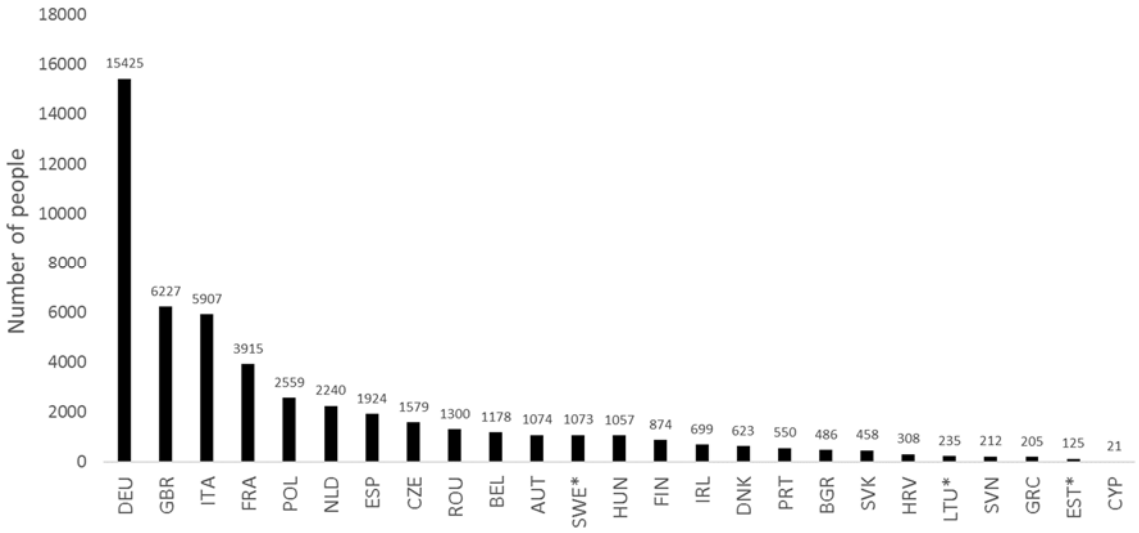
US Tariff Imposed	Job losses	
	Belgium	EU
5%	1,200	50,000
15%	5,000	240,000

In Figure 14, we show employment losses for the "optimistic Trumpit" scenario, where we break down the total EU job losses per individual EU country[28]. In absolute numbers, German job losses are largest which is not a surprise given Germany's size and its strong and export-oriented economy. Based on the input-output analysis of WIOD, more than 15,000 German jobs would be lost in a Trumpit.

The UK would be the second biggest "loser" with more than 6,000 employees lost, followed by Italy with just under 6,000 jobs. The job loss in Italy is surprising, given the much lower "connectivity to the US" (Table 1 in section 2.4) than in the UK, yet the job losses are quite similar for UK and Italy. The explanation can be found in the different sectoral compositions of UK versus Italy. For the UK (and also for France), services exports account for their high interconnectedness with the US. Both UK and France are relatively service-oriented, whereas Italy's exports are mainly driven by its manufacturing goods sectors. As discussed before, services sectors are less likely to be affected by Trumpit (where only US import tariffs on goods are increased), which explains why the job losses in Italy are relatively high compared to France and the UK.

[28] Because of data limitation, some countries were either deleted (Malta, Latvia and Luxemburg) or only studied partially (Estonia, Lithuania and Sweden). See the notes in Figures 14 and 15 on what sectors are missing in the latter group of countries.

Figure 14: Employment loss in absolute numbers for the EU member states for a Trumpit of 5%

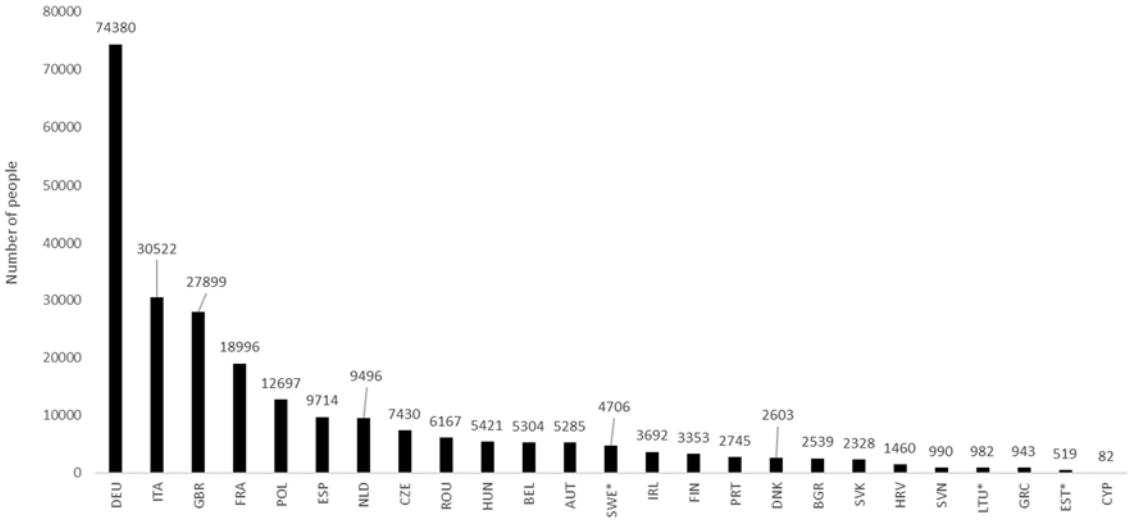


Source: Own calculations based on WIOD and Eurostat

Notes: Employment data on Eurostat is missing for the following country-sectors (Nace rev. 2): Estonia: C19, C21, C24, C30, H51, K66; Lithuania: C19; Sweden: C20, C21, H52, H53, M71, M72; Malta, Latvia and Luxembourg contain too many missing sectors and were therefore deleted.

In Figure 15, we show the employment losses but now for the "pessimistic Trumpit" scenario where all tariffs are raised to 15%. The job losses are much bigger than in the optimistic Trumpit scenario. Germany, for instance, loses almost 75,000 jobs when US import tariffs are increased to 15%. Note that the job losses in Italy now exceed those in the UK. This can be explained by Italy's strong reliance on textiles exports to the US. To see this, recall the fact that the average US import tariff on textiles is currently 9%, so this sector would not be affected by an "optimistic Trumpit" scenario in which only sectors below the 5% US import tariff would see an increase in protection. A sector like textiles with a tariff of 9% would not be affected in that case. However, in the "pessimistic Trumpit" scenario all sectors with US import tariffs below 15% would be affected by the protectionism including textiles. If tariffs on textiles go up to 15% this accounts for considerable job losses in Italy since textiles is one of Italy's main export sectors to the US.

Figure 155: Employment loss in absolute numbers for the EU member states for a Trumpit of 15%

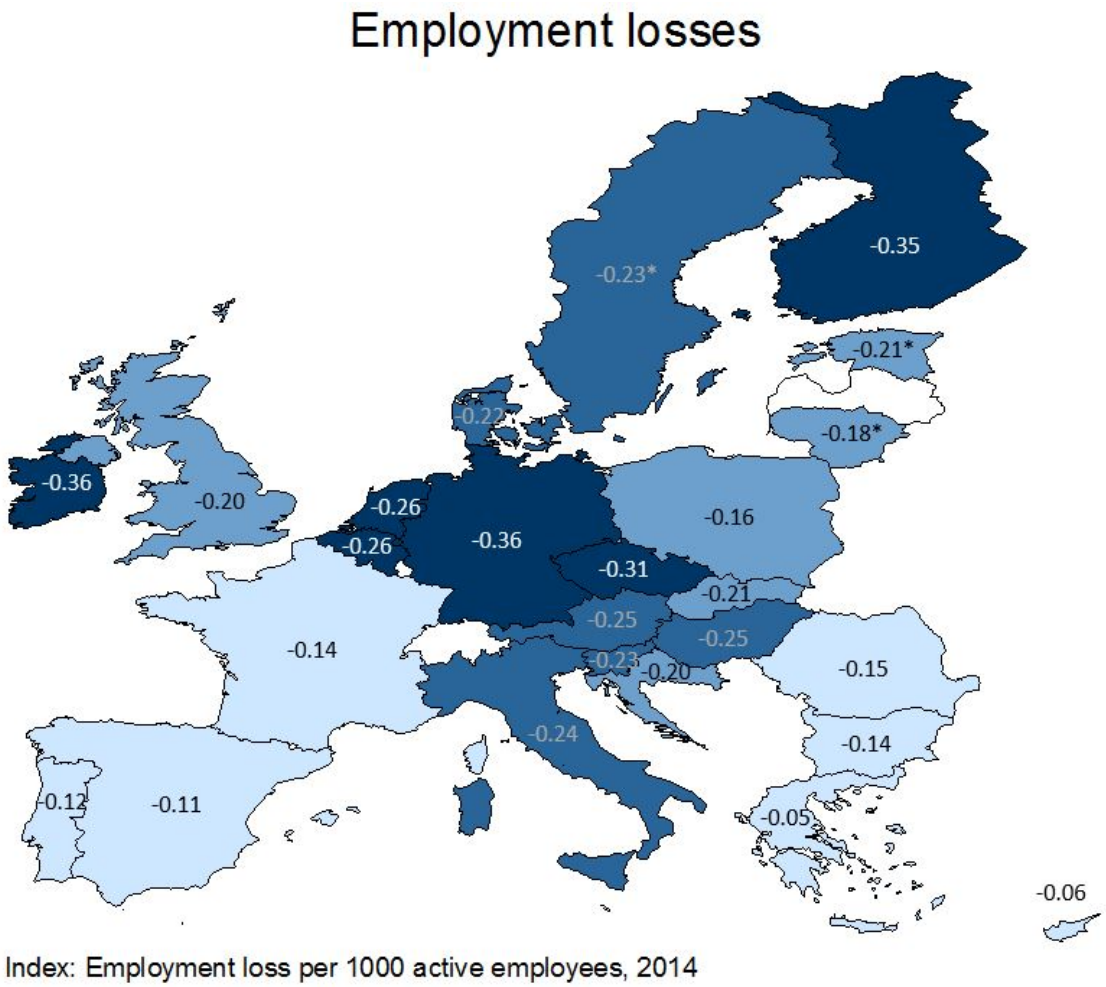


Source: Own calculations based on WIOD and Eurostat

Notes: Employment data on Eurostat is missing for the following country-sectors (Nace rev. 2): Estonia: C19, C21, C24, C30, H51, K66; Lithuania: C19; Sweden: C20, C21, H52, H53, M71, M72; Malta, Latvia and Luxembourg contain too many missing sectors and were therefore deleted.

Finally, in Figure 16, we normalize these job losses for every EU country by the size of each EU country. For example, per 1,000 active employees, 0.26 employees will be lost in Belgium because of an "optimistic" Trumpit. These normalized results reveal that Germany and Ireland, both with 0.36 jobs lost per 1,000 active employees, will be hit hardest in relative terms, while Greece will experience almost no job losses after increased US trade protectionism. Compared to other EU countries with similar GDP, Greece exports much less to the United States. The weak connection with the US is the likely explanation behind the small employment loss in Greece after Trumpit.

Figure 16: Employment loss per 1,000 active employees per EU member state for a Trumpit of 5%



Source: Own calculations based on WIOD and Eurostat

Notes: Darker shades of blue refer to countries that are more affected by US protectionism. Employment data on Eurostat is missing for the following country-sectors (Nace rev. 2): Estonia: C19, C21, C24, C30, H51, K66; Lithuania: C19; Sweden: C20, C21, H52, H53, M71, M72; Malta, Latvia and Luxembourg contain too many missing sectors and were therefore deleted.

4. Trumpit and Output loss for Belgium and the EU

In addition to the employment effects, we now investigate the loss in **output** after Trumpit, both for Belgium and the European Union.

For Belgium, in an "optimistic Trumpit" scenario we find that around 467 million dollars of output would be lost, which represents the production of goods and services by Belgian firms that was previously exported to the US in the form of EU goods but that would dry up under Trumpit. This calculated loss of 467 million dollars of Belgian output value represents 5.7% of the total 8.2 billion dollars of direct and indirect exports of Belgian firms to the US in 2014. It represents 0.1% of Belgian GDP[29]. For Belgium in a "pessimistic Trumpit", the calculated output loss would amount to 2 billion dollars. This represents 0.42% of the total Belgian GDP.

These numbers may seem small at first, but given an annual Belgian GDP growth between 0% and 2% in the last five years, a loss in GDP of 0.42% would imply a serious output loss for the Belgian economy.

For the EU as a whole, an "optimistic Trumpit" scenario of a 5% US tariff increase would result in a reduction in output of 14.3 billion dollars[30]. This corresponds to a loss of 5.3% of the total of 272 billion dollars of EU direct and indirect exports to the US in 2014. It represents 0.09% of EU GDP[31]. In the "pessimistic Trumpit" scenario, the output loss for the EU as a whole would amount to 66 billion dollars, which corresponds to 0.39% of total EU GDP.

Table 3 summarizes the output lost expressed as a percentage of GDP, in both US import tariff scenarios.

Table 3: Output lost for Belgium and EU in both scenarios of Trumpit

US Tariff Imposed	Output lost (in % of GDP)	
	Belgium	EU
5%	0.1%	0.09%
15%	0.42%	0.39%

[29] Total value added across all sectors, calculated using WIOD for 2014. This is a measure of total Gross Domestic Product.

[30] With around 50,000 EU jobs lost, this implies that for every 1 billion of EU export value to the US that is lost, around 3,500 EU jobs disappear (50,000/14.3). At first sight, this number may appear low as a recent EU Commission report estimated that 1 billion euros of European exports supports around 14,000 jobs. We argue that our numbers are more accurate since they aim to calculate employment changes due to Trumpit tariff increases and not just provide the number of jobs that are involved in exports overall.

[31] Total value added across all sectors, calculated using WIOD for 2014. This is a measure of total Gross Domestic Product.

5. Conclusion

In this paper, we estimate employment and output losses in Europe as a result of increased American protectionism on the imports of goods under US president Trump. We considered two potential tariff scenarios, an "optimistic scenario", where Trump raises import tariffs in all sectors up to 5% (The Economist, 2017) and a "pessimistic scenario" where Trump raises import tariffs to 15% (Trade Act of 1976).

In the "optimistic scenario", we find EU job losses to amount to 50,000 jobs of which 1,200 jobs lost in Belgium. This corresponds to a drop in output of around 0.1% of European and Belgian GDP. It also corresponds to exports (direct and indirect) to the US that are 5.3% lower than what they were in 2014.

In the "pessimistic scenario", we find EU job losses to amount to 240,000 jobs of which 5,000 jobs lost in Belgium. This corresponds to a drop in output of about 0.4% of European and Belgian GDP. It also corresponds to exports (direct and indirect) to the US that are 24% lower than what they were in 2014.

For Belgium, the sectoral breakdown of the job losses shows that the "chemical sector" is likely to suffer most job losses together with the services sectors "Administrative support activities" and "Legal and Accounting services". While a similar sectoral breakdown can be obtained for the other EU member states, we have thus far not pursued it here for brevity.

In terms of differences between EU member states, we clearly see that their connectivity to the US economy varies. We measure "connectivity to the US" in terms of the number of employees that are involved in supporting direct and indirect exports to the US. When normalizing for country size, countries like Ireland, Belgium and the Netherlands are amongst the most highly connected to the US economy. However, in absolute numbers, the connectivity to the US is highest in the larger countries, i.e. Germany and the UK and, to a lesser extent, France and Italy.

The job losses per EU member state is a reflection of the "connectivity to the US" but also a reflection of the "goods versus services composition" of the EU country's exports. For example, while the "connectivity to the US" for France and Italy are about the same, Italy suffers larger job losses under Trumpit than France. The reason is that France exports relatively more services while Italy exports relatively more goods to the US.

This study is a first pass at measuring the potential economic impact of American trade policy. However, there are a number of contingencies that may occur that we have not taken into account thus far.

For instance, the American protectionist measures could potentially result in retaliation by US trade partners, such as China. If the United States impose higher tariffs on Chinese imports, China may react by increasing their own import tariffs on goods coming from the US. These kinds of trade wars can be particularly harmful for the world economy at large, including the EU.

If the EU itself also retaliates and imposes higher tariffs on goods coming from the US goods, the EU job losses could potentially even be much higher. In this analysis, however, we do not consider retaliation and only look at the short-run effects of increased American protectionism.

Similarly, in this study we did not go as far as to consider that an increase in US import tariffs could trigger more inward foreign direct investment (FDI) into the US from Europe. Higher US import tariffs may induce European firms to set up affiliates in the US and hire local workers to the detriment of EU employment. These EU employment effects have not been taken on board. Instead, in this analysis, we have focused on EU employment effects stemming from lower EU exports resulting from increased American protectionism on the imports of goods.

Appendix

In this Appendix, we document how we use the World Input-Output Database (WIOD) to obtain an estimate of the number of Belgian employees involved in worldwide exports to the United States. This means that in addition to direct exports from Belgium to the US, we also consider production of Belgium that is used by other countries in the production of their own exports to the US.

Table A1 shows the structure of the WIOD tables where countries are represented by letters A-Z and sectors by numbers 1-56. The rows show the use of total gross output of a given country-industry in other sectors and countries. The columns show the inputs from other industries and countries used in the production of gross output of a given country-industry. For instance, assume that "Country A" represents Belgium and "Industry 1" identifies the sector "Manufacture of motor vehicles". The first row of Table A1 indicates that the output of the Belgian "Motor vehicles" industry is used as inputs in all Belgian industries (including "Motor vehicles" itself), all foreign sectors and to be sold as final goods in Belgium and in all other countries. This way, the sum of each row represents the total output of a given country-sector. On the other hand, the Belgian "Motor vehicles" sector needs inputs to produce this total output. These inputs are sourced from all Belgian sectors (including "Motor vehicles" itself) as well as all foreign industries. For instance, Belgian cars might be produced using Belgian steel and German leather. The sum of all these inputs is the column-sum "Total Intermediate Inputs". The difference between this sum of inputs and the total gross output for a given country-sector (calculated as the sum of the corresponding row) represents the value added (VA) of this particular sector. Assuming that each country has a representative firm in each industry producing a single product, we can obtain the standard I-O matrix from Table A1:

$$Y = D_I + D_F = AY + D_F$$

$$D_F = (I - A)Y$$

$$Y = (I - A)^{-1} D_F = L D_F$$

Where Y denotes "Total output", D_I is "Total intermediate demand", D_F is "Total final demand", A is a technological coefficient matrix representing the inputs used in production, I is the identity matrix and L denotes the Leontief inverse parameter (Leontief , 1970)[32].

[32] Leontief, W. (1970). "Environmental Repercussions and the Economic Structure: An Input-Output Approach". The Review of Economics and Statistics, 52(3), 262-271.

Table A1. WIOD Structure

		Intermediate Demand							Final Demand			Total Output
		Country A			…	Country Z			Country A	…	Country Z	
		Industry 1	…	Industry 56	…	Industry 1	…	Industry 56		…		
Country A	Industry 1	Input use by Industry 1 from Industry 1, (Domestic output)	…	Input use by Industry 56 from Industry 1, (Country A output)	…	Input use by Industry 1 from Industry 1, (Foreign output)	…	Input use by Industry 1 from Industry 56, (Foreign output)	Final use by Country A from Industry 1, (Domestic output)	…	Final use by Country Z from Industry 1, (Foreign output)	Total Output (Industry 1)
	…	…	…	…	…	…	…	…	…	…	…	…
	Industry 56	Input use by Industry 1 from Industry 56, (Country A output)	…		…		…			..		
…	…	…	…	…	…	…	…	…	…	…	…	…
Country Z	Industry 1	Input use by Industry 1 from Industry 1, (Country Z output)	…		…		…					
	…	…	…		…		…	…	…	…	…	…
	Industry 56	Input use by Industry 1 from Industry 56, (Country Z output)	…		…		…			…		
Total Intermediate Inputs		Inputs (Sum) Industry 1, Country A	…	Inputs (Sum) Industry 56, Country A	…	Inputs (Sum) Industry 1, Country Z	…	Inputs (Sum) Industry 56, Country Z				
Value Added (VA)		Country A, (Industry1): [Total Output - Inputs (Sum)]	…	Country A (Industry 56): [Total Output - Inputs (Sum)]	…	Country Z (Industry 1): [Total Output - Inputs (Sum)]	…	Country Z (Industry 56): [Total Output - Inputs (Sum)]				

Decomposing Global Value Chains using WIOD

Our objective is to decompose the value that is generated by an industry in a specific country into the contributions of every country-sector. As described above, we use Leontief (1936) to identify the origin of the different inputs used in a given country-sector to produce the total output. To calculate such a decomposition of the global value chain, we start with the matrix "va" which represents value added per unit of total output for each country-industry: $\{va = VA/Y\}$, where VA is obtained by subtracting total inputs from total output as described above and Y represents total output of the country-industry. Using the Leontief parameter, we can then we obtain the decomposition of the global value chains for each country-industry:

$$\begin{pmatrix} O_{A,A}^{1,1} & \dots & O_{A,Z}^{1,56} \\ \vdots & \ddots & \vdots \\ O_{Z,A}^{56,1} & \dots & O_{Z,Z}^{56,56} \end{pmatrix} = \begin{pmatrix} va_A^1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & va_Z^{56} \end{pmatrix} \begin{pmatrix} L_{A,A}^{1,1} & \dots & L_{A,Z}^{1,56} \\ \vdots & \ddots & \vdots \\ L_{Z,A}^{56,1} & \dots & L_{Z,Z}^{56,56} \end{pmatrix} \begin{pmatrix} Y_A^1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & Y_Z^{56} \end{pmatrix}$$

In order to understand what matrix O represents, consider the last element of the first row, $O_{A,Z}^{1,56}$. This element captures the value added generated by country A's sector 1 that is used in the production of total output of country Z's sector 56. Similarly, $O_{A,A}^{1,1}$ denotes the VA generated by country A's sector 1 used in its own total output, which we label "Domestic Own Industry Value Added (DOIVA)". Summing over all the other elements in the first column, $O_{A,A}^{2,1}$ to $O_{Z,A}^{56,1}$, we obtain the "Other Industries Value Added (OIVA)"[33] for country A's industry 1. The sum of both DOIVA and OIVA for each country-sector pair, which corresponds to the sum of all elements in the column, equals its total output. Table A2 depicts this matrix O.

[33] Note that the "other industries" include both goods and services.

Table A2: Decomposition of Global Value Chains

		Final Product of Global Value Chain, identified by country and industry of completion							Value Added
		Country A			…	Country Z			
		Industry 1	…	Industry 56	…	Industry 1	…	Industry 56	
Country A	Industry 1	Value Added Generated by Industry 1 from Country A that is used to produce Country A-Industry 1 total output	…	Value Added Generated by Industry 1 from Country A that is used to produce Country A-Industry 56 total output	…	Value Added Generated by Industry 1 from Country A that is used to produce Country Z-Industry 1 total output	…	Value Added Generated by Industry 1 from Country A that is used to produce Country Z-Industry 56 total output	
	…	…	…	…	…	…	…	…	
	Industry 56								
…	…	…	…	…	…	…	…	…	
Country Z	Industry 1		…		…		…		
	…		…		…		…		
	Industry 56		…		…		…		
Total Final Output Value			…		…		…		World GDP

Source: Timmer et al (2014)34

Decomposing Global Value Chains in Exports

A similar exercise can be done for each country-industry's total exports. Like total output *Y*, exports *X* are decomposed as:

$$\begin{pmatrix} E_{A,A}^{1,1} & \dots & E_{A,Z}^{1,56} \\ \vdots & \ddots & \vdots \\ E_{Z,A}^{56,1} & \dots & E_{Z,Z}^{56,56} \end{pmatrix} = \begin{pmatrix} va_A^1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & va_Z^{56} \end{pmatrix} \begin{pmatrix} L_{A,A}^{1,1} & \dots & L_{A,Z}^{1,56} \\ \vdots & \ddots & \vdots \\ L_{Z,A}^{56,1} & \dots & L_{Z,Z}^{56,56} \end{pmatrix} \begin{pmatrix} X_A^1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & X_Z^{56} \end{pmatrix}$$

In matrix *E*, element $E_{A,Z}^{1,56}$ represents the value added generated in country A's industry 1 that is used in the production of total exports of country Z's sector 56. Similarly, $E_{A,A}^{1,1}$ denotes the VA generated

[34] Timmer et al (2014). "Slicing Up Global Value Chains". Journal of Economic Perspectives. Volume 28, Number 2, Spring 2014, Pages 99-118

by country A's sector 1 used in its own exports, which we label "Domestic Own Industry Value Added of Exports (DOIVAX)". Summing over all the other elements in the first column, $E_{A,A}^{2,1}$ to $E_{Z,A}^{56,1}$, we obtain the "Other Industries Value Added on exports (OIVAX)" for country A's industry 1. The sum of both DOIVAX and OIVAX for each country-sector pair, which corresponds to the sum of all elements in the column, equals its total exports. Matrix *E* is shown in Table A3.

From Table A3, we can also obtain the Domestic Value Added (DVA) content of exports of every country-industry pair. Summing over the elements $E_{A,A}^{1,1}$ to $E_{A,A}^{56,1}$ in the first column, for instance, yields the DVA of exports from industry 1 in country A. This is the VA embedded in this country-industry's exports that was produced in all sectors (both goods and services) in country A. The sum of the other elements in the first column, $E_{B,A}^{1,1}$ to $E_{Z,A}^{56,1}$, represents the Foreign Value Added (FVA) of the country-industry exports. This amount corresponds to the sum of the inputs from all foreign sectors used in the production of exports from industry 1 in country A.

On the other hand, the output of a given country-sector is used in the production of other sectors (both domestic and foreign) as well. In order to obtain the total production of country A's industry 1 that is used as inputs in other domestic sectors to produce exports, we need to sum over the elements $E_{A,A}^{1,2}$ to $E_{A,A}^{1,56}$ in the first row, which yields this country-sector's "Indirect Value Added Domestic Exports (IVADE)". Similarly, the sum of the elements $E_{A,B}^{1,1}$ to $E_{A,Z}^{1,56}$ in the first row corresponds to the "Indirect Value Added Foreign Exports (IVAFE)" of industry 1 in country A. This is the production of A1 that is used in all sectors abroad to produce goods and services that are then exported.

Table A4 shows the same decomposition for exports to the US instead of exports to the world like in Table A3. The reasoning does not change. For every country-industry pair, this table shows how much inputs it uses from other (domestic and foreign) sectors, represented by the column, to produce its exports to the US. Analogously, each row captures how much of the corresponding country-industry is used in other (domestic and foreign) sectors as input in the production of their exports to the US. The total sum of a row equals TVAXUS, the "Total Value Added embedded in Exports to the US" of a particular country-sector pair. The benefit of using VA in the analysis is that TVAXUS does not include inputs from other (domestic and foreign) sectors, which allows to investigate the linkage between a country-industry and the US most accurately.

Table A3: Decomposition of Global Value Chains in terms of exports

		Final Product of Global Value Chain, identified by country and industry of completion							Total Value Added
		Country A			…	Country Z			
		Industry 1	…	Industry 56	…	Industry 1	…	Industry 56	
Country A	Industry 1	Value Added Generated by Industry 1 from Country A that is used to produce Country A-Industry 1 total exports	…	Value Added Generated by Industry 1 from Country A that is used to produce Country A-Industry 56 total exports	…	Value Added Generated by Industry 1 from Country A that is used to produce Country Z-Industry 1 total exports	…	Value Added Generated by Industry 1 from Country A that is used to produce Country Z-Industry 56 total exports	
	…	…	…	…	…	…	…	…	
	Industry 56								
…	…	…	…	…	…	…	…	…	
Country Z	Industry 1		…		…		…		
	…		…		…		…		
	Industry 56		…		…		…		
Total Exports			…		…		…		Total World Exports

Table A4: Decomposition of Global Value Chains in terms of exports to the US

		Final Product of Global Value Chain, identified by country and industry of completion							Total Value Added
		Country A			…	Country Z			
		Industry 1	…	Industry 56	…	Industry 1	…	Industry 56	
Country A	Industry 1	Value Added Generated by Industry 1 from Country A that is used to produce Country A-Industry 1 total US exports	…	Value Added Generated by Industry 1 from Country A that is used to produce Country A-Industry 56 total US exports	…	Value Added Generated by Industry 1 from Country A that is used to produce Country Z-Industry 1 total US exports	…	Value Added Generated by Industry 1 from Country A that is used to produce Country Z-Industry 56 total US exports	
	…	…	…	…	…	…	…	…	
	Industry 56								
…	…	…	…	…	…	…	…	…	
Country Z	Industry 1		…		…		…		
	…		…		…		…		
	Industry 56		…		…		…		
Total US Exports			…		…		…		Total US Exports

Employment data and the decomposition of Global value chains

The final aim of this analysis is to identify, for a particular country-industry pair, the employment used in the production of direct and indirect exports to the US. These are the employees that are potentially affected by a US tariff increase. As tariffs are typically imposed on goods and not on services, we only consider direct exports of goods to the US. Belgian services are used as inputs in the exports of goods to the US of other (domestic and foreign) industries, however. A German car manufacturer, for instance, might use Belgian marketing advice to sell its cars in the US. It is important to take into account these Belgian services that are indirectly exported to the US in the form of goods. Therefore, the resulting Belgian employment number in our analysis covers all Belgian employees that produce (i) services that are used as input in world exports of goods to the US and (ii) goods that are either exported directly to the US or are used as input in world exports of goods to the US. We label this number "US devoted Belgian employment".

To calculate this number, we use the information in Tables A2 and A4. In particular, we divide TVAXUS (Total Value Added embedded in Exports to the US from Table A4) by DOIVA (Domestic Own Industry Value Added from Table A2) for each country-industry pair to obtain the share of the industry's total VA that is somehow embedded in exports to the US. In order to generate TVAXUS, we assume that an industry employs a number of employees proportionate to those employed to generate the total industry's VA, DOIVA. Then, the total "US devoted Belgian employment" can be obtained by multiplying the share of TVAXUS in DOIVA by total employment for every Belgian sector (goods and services) and summing over all sectors.

From Import Tariff change into Domestic Price changes

In this section, we examine how a change in tariffs affects prices. Assuming complete pass-through[35], we can adapt the following relationship between tariffs and prices from Van Biesebroeck and Vandenbussche (2016):

$$\frac{P_1 - P_0}{P_0} = \frac{(1+\tau_1) - (1+\tau_0)}{(1+\tau_0)} \qquad (1)$$

where P_1 denotes the new price, i.e. the price after the increased protection measures are imposed and P_0 is the old price that was charged before the increased protection. Similarly, τ_1 is the new tariff rate and τ_0 is the current tariff rate. As we discussed in Section 2.1., the average τ_0 on EU imports across all sectors equals around 2.1% at this moment. Equation (1) shows that, under complete pass-through, the percentage change in prices corresponds closely to the change in imposed tariffs. An increase in tariffs from 5% to 10% (a 5 percentage point increase) raises prices with (0.05)/1.05 = 4.8%, for instance.

In order to know how much the price of imported goods in a specific sector will go up after an additional tariff is imposed, we only need information about the current tariff, τ_0, and the new tariff τ_1. In Section 2.1., we gave an overview of the current US tariffs on EU goods in all sectors. The new tariff τ_1 is the hypothetical tariff of 5% or 15% we expect Donald Trump to impose when he is sworn in as President on January 20, 2017. Using the information on τ_0 we can then compute the proportionate price increase in every sector after the trade protection.

[35] Complete pass-through means that every cost increase or decrease is passed on completely to consumers. A tariff essentially imposes an additional cost to firms. Assuming complete pass-through, we expect firms that face a tariff to increase their prices by the exact amount of the tariff, leaving their FOB (Free On Board) prices unchanged. Whether or not realistic, this is a feature of most trade models of monopolistic competition where preferences are expressed with a CES utility function (Melitz, 2003).

Table A5: Sectors in WIOD

	Nace Rev.2	Sector_legend	Sector_Legend_Short
Tradable Sectors	A01	Crop and animal production, hunting and related service activities	Live Animals
	A02	Forestry and logging	Forestry
	A03	Fishing and aquaculture	Fishing
	B	Mining and quarrying	Mining and quarrying
	C10-C12	Manufacture of food products, beverages and tobacco products	Food Product
	C13-C15	Manufacture of textiles, wearing apparel and leather products	Textiles
	C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	Wood and Cork
	C17	Manufacture of paper and paper products	Paper Products
	C18	Printing and reproduction of recorded media	Printing and Media
	C19	Manufacture of coke and refined petroleum products	Petroleum Products
	C20	Manufacture of chemicals and chemical products	Chemicals
	C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	Pharmaceutical
	C22	Manufacture of rubber and plastic products	Rubber and Plastic
	C23	Manufacture of other non-metallic mineral products	Other Non-metallic mineral
	C24	Manufacture of basic metals	Basic Metals
	C25	Manufacture of fabricated metal products, except machinery and equipment	Metal products
	C26	Manufacture of computer, electronic and optical products	Electronics and Computers
	C27	Manufacture of electrical equipment	Electrical Equipment
	C28	Manufacture of machinery and equipment n.e.c.	Machinery & Equipment
	C29	Manufacture of motor vehicles, trailers and semi-trailers	Motor vehicles
	C30	Manufacture of other transport equipment	Other Transport equipment
	C31_C32	Manufacture of furniture; other manufacturing	Furniture & other manufac.
	C33	Repair and installation of machinery and equipment	Installation of machinery
	D35	Electricity, gas, steam and air conditioning supply	Electricity & Gas
	E36	Water collection, treatment and supply	Water Collection Activities
	E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services	Waste Collection Activities
Non Ttradable Sectors	F	Construction	Construction
	G45	Wholesale and retail trade and repair of motor vehicles and motorcycles	Wholesale and retail trade
	G46	Wholesale trade, except of motor vehicles and motorcycles	Wholesale trade
	G47	Retail trade, except of motor vehicles and motorcycles	Retail trade
	H49	Land transport and transport via pipelines	Land & Pipeline transport
	H50	Water transport	Water transport
	H51	Air transport	Air transport
	H52	Warehousing and support activities for transportation	Warehousing
	H53	Postal and courier activities	Postal
	I	Accommodation and food service activities	Accommodation & Food serv.
	J58	Publishing activities	Publishing Act.
	J59_J60	Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities	Media Production
	J61	Telecommunications	Telecom
	J62_J63	Computer programming, consultancy and related activities; information service activities	Computer Programming, consultancy
	K64	Financial service activities, except insurance and pension funding	Financial Services
	K65	Insurance, reinsurance and pension funding, except compulsory social security	Insurance
	K66	Activities auxiliary to financial services and insurance activities	Auxiliary Financial Serv.
	L68	Real estate activities	Real Estate
	M69_M70	Legal and accounting activities; activities of head offices; management consultancy activities	Legal and Accounting
	M71	Architectural and engineering activities; technical testing and analysis	Architectural and engineering act.
	M72	Scientific research and development	Scientific Research
	M73	Advertising and market research	Advertising and market research
	M74_M75	Other professional, scientific and technical activities; veterinary activities	Other professional activities
	N	Administrative and support service activities	Administrative and support act.
	O84	Public administration and defence; compulsory social security	Public admin and defence
	P85	Education	Education
	Q	Human health and social work activities	Health
	R_S	Other service activities	Other services
	T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	Activities of households as employers
	U	Activities of extraterritorial organizations and bodies	Extraterritorial Activities

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